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ABSTRACT

This report summarizes two nationwide studies conducted by the National Assessment of Educational Progress (NAEP), in 1969-70 and 1972-73, in which information was gathered on the skills and knowledge in science of respondents aged 9, 13, and 17. Included in this report are: a description of the sample used and the science exercises used; statistical results of the studies according to age, region of the country, sex, and region and type of community; and supplementary graphs and tables displaying the data. (MH)

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HIGHLIGHTS AND TRENDS FROM NATIONAL ASSESSMENT: CHANGES IN SCIENCE ACHIEVEMENT, 1969-1973

by

Judith M. Sauls

National Assessment of Educational Progress

Paper presented at annual convention of American Educational Research Association, San Francisco, April, 1976.

SE 021 249

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Changes in Science Achievement, 1969-1973

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National Assessment of Educational Progress

Introduction

Although suspicions have been growing among scientists and non-scientists alike that public knowledge of and interest in science has declined in recent years until recently there has been no national data that could either substantiate or refute these suspicions. The National Assessment of Educational Progress, funded by the Office of Education, has been monitoring the nation's progress in education in response to a charge set before the Office of Education in 1867. Only recently has that century-old charge been addressed in a systematic way. More than 100 years later in 1969 National Assessment first began collecting data that would report on the nation's progress in education. This paper outlines the results found to date in the area of science, one of ten areas periodically assessed by National Assessment.

National Assessment has now completed two major assessments of science. The first took place in the 1969-70 school year and the second in the 1972-73 school year. In both assessments information was gathered on the skills and knowledge in science of 9-year-olds, 13-year-olds and 17-year-olds in school, age levels which mark the end of primary, intermediate and secondary education. Since some identical questions were used in both assessments, National Assessment has available concrete information on the progress or decline of knowledge in science.

The Samples Used

In both assessments of science, National Assessment selected respondents aged 9, 13 and 17 using a deeply-stratified, multi-stage probability sample with a controlled selection procedure for first stage sampling units. From these carefully selected respondents, it is possible to estimate how the entire population of 9-, 13-, and 17-year-olds would have responded if all students at those ages had responded to the questions. Thus each piece of data reported by National Assessment is an estimate of a corresponding population value, i.e., as if all 9-year-olds had responded. The assessments were not longitudinal; different individuals participated in each of the assessments. Participants represent students in that particular year. The population estimates are then compared to determine the changes in performance for each age.

In addition to reporting estimates of performance for each age, National Assessment also estimates performance for groups of respondents, characterized by sex, color, region of the country, highest level of parental education and size and type of community.

The Exercises Used

The exercises used to report change in science achievement were originally written for the first assessment of science administered in 1969-70. About half of the exercises used in that assessment were not released to the public so that they could be used in the second assessment of science to measure change. There were 92 such exercises at age 9, 67 at age 13 and 64 at age 17. After the second assessment, about two-thirds of these exercises were released and can be found in Changes in Science Performance,

1969-1973: Exercise Volume (Science Report No. 04-S-20, December, 1975).* The remaining one-third of these exercises will be used in the next assessment of science, currently scheduled for 1976-77, to monitor change over three points in time.

When these exercises were classified by type of science, the majority were from the physical sciences:

	Physical Science	Biological Science	Other	Total
Age 9	50	27	15	92
Age 13	36	23	8	67
Age 17	39	20	5	64

Measuring Change

National Assessment does not use a "test" that contains all science exercises for an age. Instead each respondent takes only a fraction of the total number of exercises, spending about 45 minutes on the task. Total "test" scores are not calculated. However, it is possible to estimate the national proportion correct on each exercise from the sample responses, and then find the mean of these percentages across all exercises to characterize the general performance of a group.

To estimate change on each exercise the 1969-70 percentage correct was subtracted from the 1972-73 percentage correct. A positive difference indicates better performance in 1972-73 than in 1969-70 and a negative difference indicates a decline from 1969-70 to 1972-73.

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*Obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402.

For example, 13-year-olds were asked the following question (101103-2) in both assessments.

> An average serving of which of the following foods would provide the most protein for building and repairing body tissues?
>
> ⬭ Boiled potatoes
> ⬭ Green beans
> ⬬ Lean meat
> ⬭ Oatmeal
> ⬭ White bread
>
> ⬭ I don't know.

In 1969, 53% of the 13-year-olds correctly chose lean meat as the best protein source. In 1972, 49% of the 13-year-olds chose the correct answer, a decline from 1969 of 4%. With approximately 3.6 million 13-year-olds in the nation, a 4% drop means that if all 13-year-olds had responded to that question, approximately 144,000 fewer 13-year-olds would have answered the question correctly in 1972 as in 1969.

Changes in <u>group</u> performance were measured two different ways: 1) by changes in the percentage of success for that group and, 2) by changes in the group's position relative to the nation. By observing these two changes we can determine, first, whether a larger or smaller proportion of respondents answered a question correctly in 1972-73 than in 1969-70 and, second, whether or not

there was a change in the group's standing relative to the nation as a whole. Both types of information contribute to an understanding of how the performance of a given group changed. The following example illustrates these two types of change data.

This exercise (101077-1) was asked of 9-year-olds in 1970 and again in 1973.

Putting sand and salt together makes

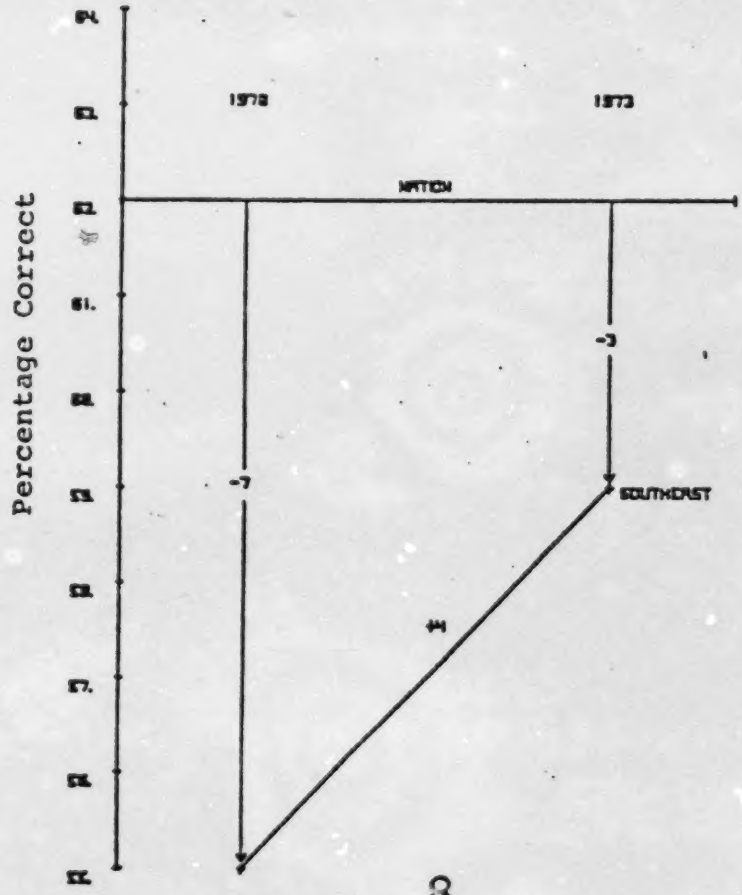
- ⬭ a chemical.
- ⬭ a compound.
- ⬭ an element.
- ● a mixture.
- ⬭ a solution.
- ⬭ I don't know.

In the first science assessment, 62% of the 9-year-olds correctly identified that putting sand and salt together makes a mixture. In that same year, 55% of the Southeastern 9-year-olds chose the correct answer, seven percentage points fewer than the national percentage correct. When asked the identical question in 1973, again 62% of the 9-year-olds answered the question correctly; there was no change in the national performance. But the Southeastern 9-year-olds responded better in 1973 than they did in 1972. Their percentage correct rose to 59%, an improvement of four percentage points from 1970. Since the national level remained the same, the Southeast performance also showed a gain in its relative position.

Although Southeastern performance on this exercise was still below the national level in 1973, there was considerable improvement relative to Southeastern achievement in 1970. The gap between national performance and the performance of Southeastern 9-year-olds appreciably narrowed between the assessments on this exercise. These changes are displayed in Exhibit 1.

The mean was used to summarize how the correct proportions changed from 1969-70 to 1972-73 and how a group's relative position changed.

EXHIBIT 1. An Example of Change in Southeast Performance on Exercise 101077-1



National Results

A comparison of the 1969-70 National Assessment science results with those of 1972-73 indicates that 9-year-olds, 13-year-olds and 17-year-olds did not perform as well in 1972-73 as they did in 1969-70. As measured by National Assessment exercises, knowledge, understanding and application of fundamental facts and principles generally declined among American students aged 9, 13 and 17 (see Exhibit 2).

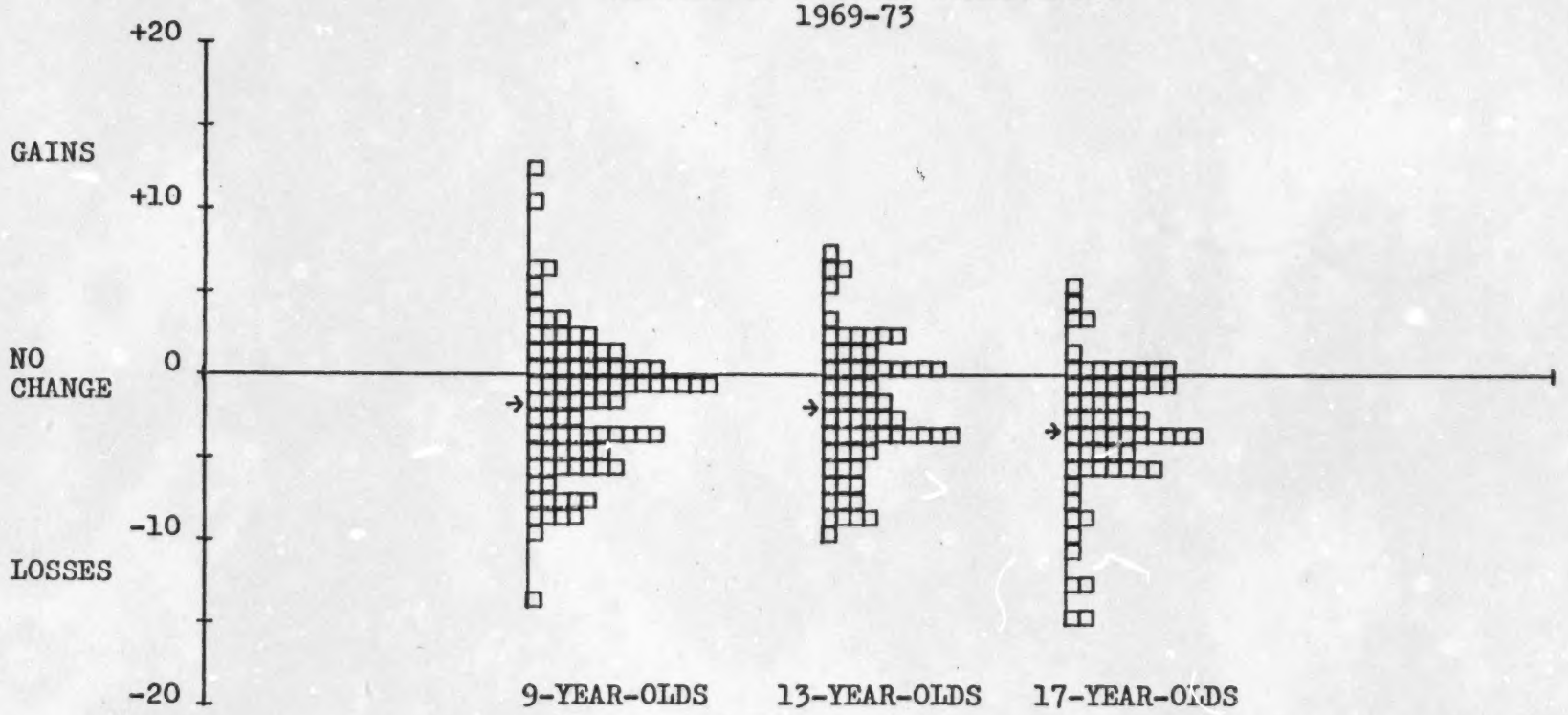
On the 92 repeated science exercises asked of 9-year-olds in both assessments, approximately one-third of the exercises showed gains; that is, on these exercises more 9-year-olds responded correctly in 1973 than in 1970. However, two-thirds of the exercises showed losses: fewer 9-year-olds answered these exercises correctly. The average change, shown by the arrow in Exhibit 2, was a mean decline of 1.7. This decline suggests that on the average 1.7% fewer 9-year-olds (an estimated 65,000) would answer a typical science question correctly in 1973 than would have done so in 1970.

At age 9 the changes observed under each type of science appear to follow closely the same downward trend observed for all repeated exercises: the physical science exercises showed a mean decline of 2.0 percentage points, the biological exercises were down by 1.6 percentage points and the unclassified showed a mean decline of 0.8 percentage points.

In general, the performance of 13-year-olds, like that of 9-year-olds, declined between 1969 and 1972. Again, there were gains on about one-third of the repeated exercises (24 out of a total of 67); that is, on these exercises more 13-year-olds

EXHIBIT 2

CHANGES IN SCIENCE ACHIEVEMENT
1969-73



Each box represents the change in performance on one science exercise. Arrows indicate the mean change: -1.7 at age 9, -1.9 at age 13 and -3.2 at age 17.

responded correctly in 1972 than in 1969. On the remaining two-thirds (43 out of 67), there were losses; fewer 13-year-olds could answer these exercises correctly. The average or mean change was a decline of 1.9 percentage points (as shown by the arrow in Exhibit 2) indicating that an estimated 70,000 fewer 13-year-olds would have responded acceptably to a typical science question in 1972 than would have in 1969.

On physical science exercises 13-year-olds showed a mean decline of 2.7 percentage points; about one-fifth of these exercises showed gains in 1972-73, the remaining four-fifths showed losses. The biological exercises showed a mean decline of 1.4 percentage points; about half showed gains and half showed losses. On the unclassified exercises, there was a reversal: gains outnumbered losses by five to three. However, due to the small number of exercises in this category, these results should be viewed cautiously.

Seventeen-year-olds enrolled in school showed the largest drop in average performance of the three school-age groups of respondents. As shown in Exhibit 2, the mean change in performance was a decline of 3.2 percentage points, indicating that on the average about 3% fewer 17-year-olds answered a typical science exercise correctly in 1973 than did so in 1970. The ratio of gains to losses was more extreme than for 9- and 13-year-olds: only one-fifth of the exercises (13 out of a total of 64) showed gains while four-fifths (51 out of 64) showed declines.

The mean change for physical science exercises taken by 17-year-olds was a decline of 4.0 percentage points, just slightly larger than the overall decline of 3.2. Only five of the 39

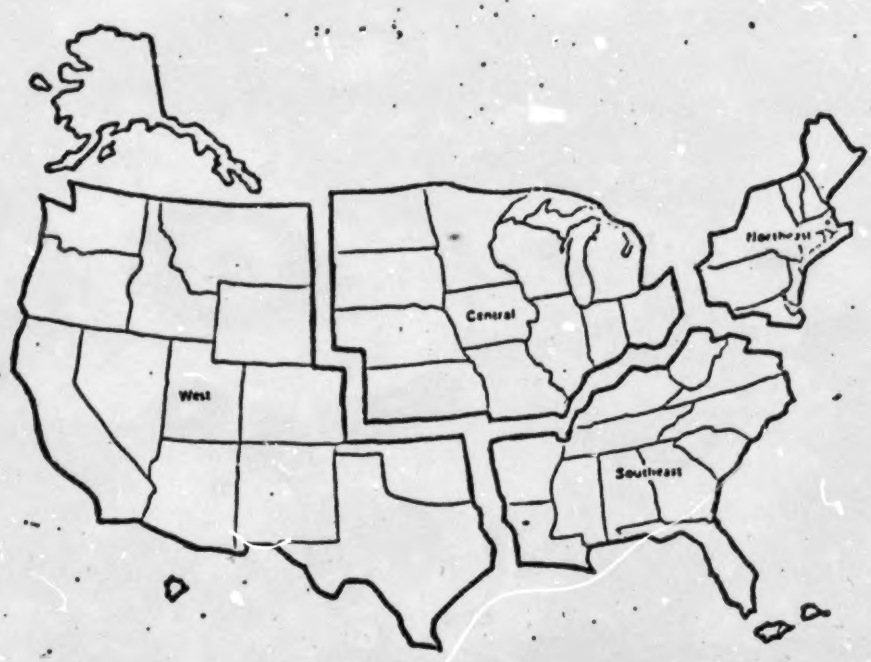
physical science exercises showed improved 1973 performance. Biological science exercises fared much better than the rest of the exercises: their mean change was a decline of only 1.6 percentage points with about 30 percent of those exercises showing improvements. The five unclassified exercises showed a mean decline of 3.7 percentage points.

Summary of National Results

At all three ages there was an average drop of two to three percentage points of students who could correctly respond to a typical National Assessment science question. These declines tended to persist regardless of the type of science assessed. About two thirds of the exercises administered to 9- and 13-year-olds in both assessments showed declines from 1969 to 1973; at age 17 about four-fifths of the exercises showed declines.

Regional Results

National Assessment divides respondents into four groups based on where they live: Northeast, Southeast, Central or West.



When the respondents were classified by these four regions and the results of the 1972-73 national science assessment were compared to those of 1969-70, all regions except the Southeast showed general declines in achievement that paralleled the national declines. The Southeast students showed smaller declines than the national results at ages 9 and 17 and actually showed an average gain at age 13. Although the Southeast had the lowest performance level of any region, its position relative to the nation improved at all three ages from 1969 to 1973.

EXHIBIT 3. Changes for Regional Groups, Age 9

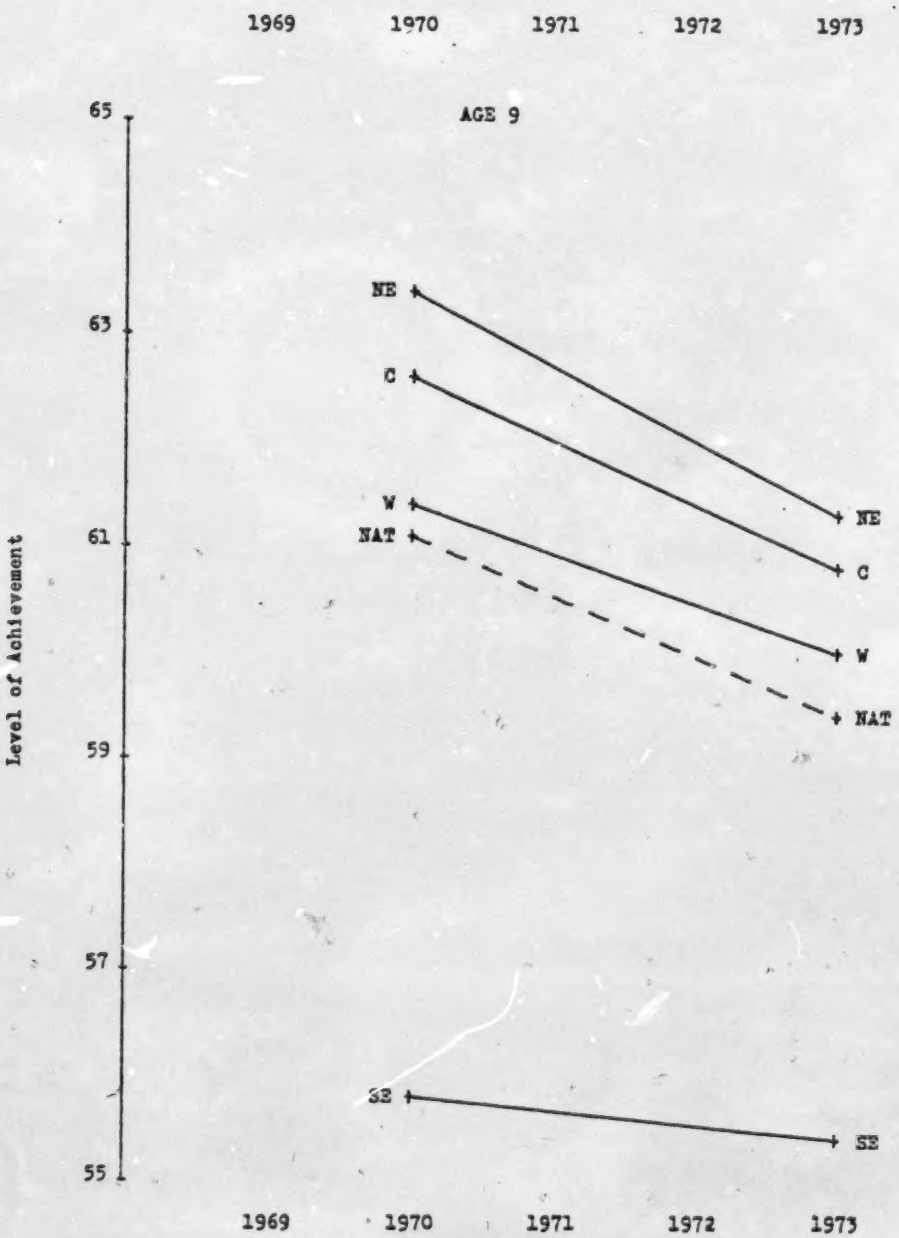


EXHIBIT 4. Changes for Regional Groups, Age 13

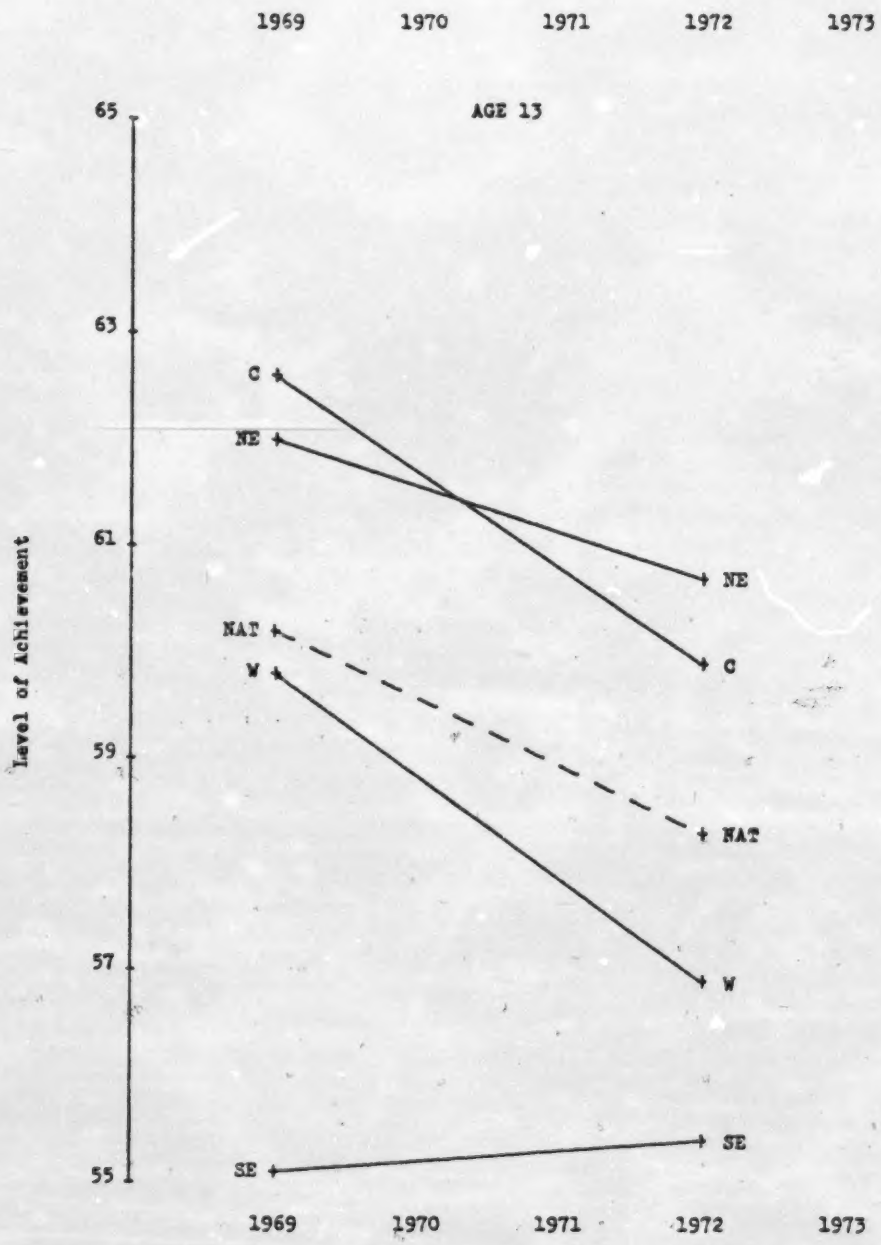
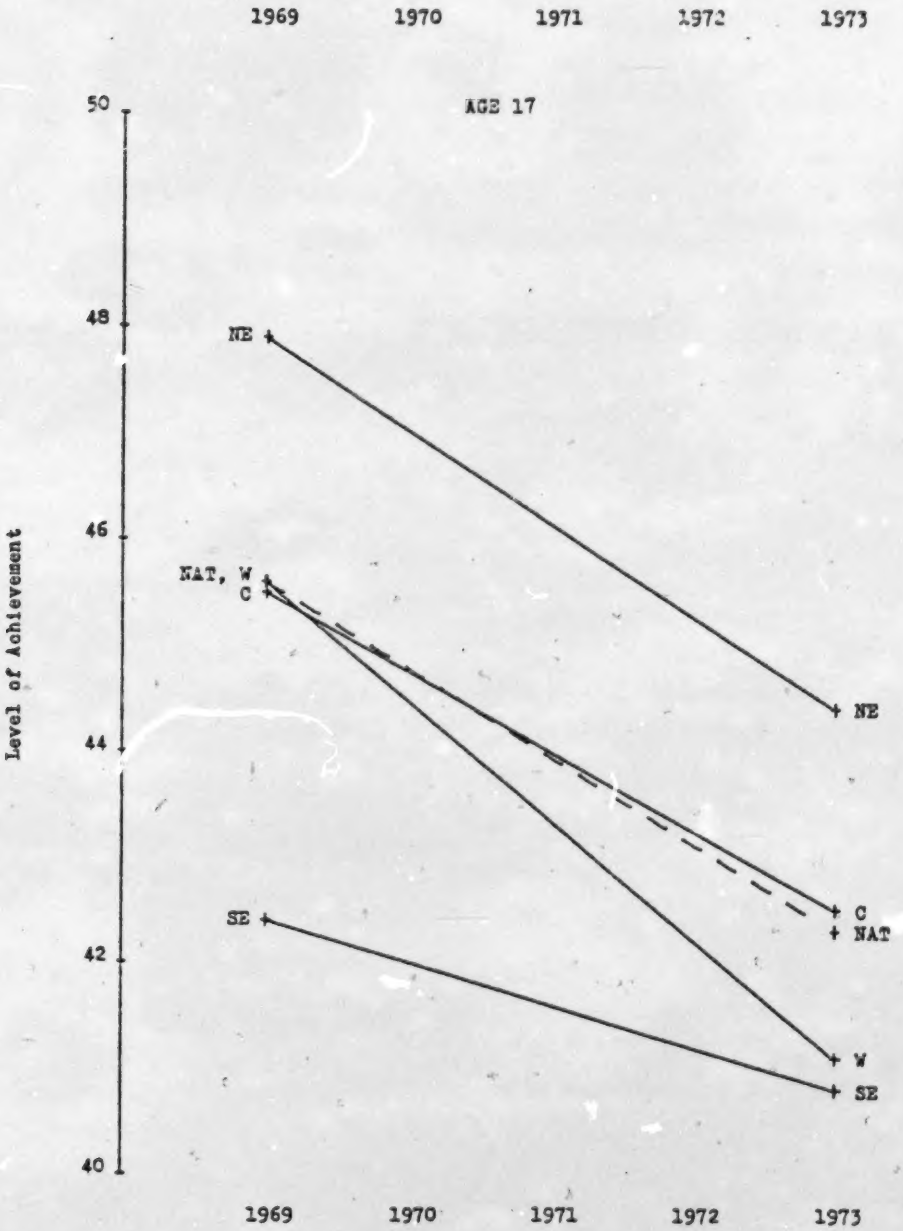


EXHIBIT 5. Changes for Regional Groups, Age 17



Results for Boys and Girls

Both boys and girls showed general declines in performance between 1969 and 1973 that closely paralleled those observed for the nation as a whole. Comparing the 1969-70 results to the 1972-73 results shows that both boys and girls showed average declines of about the same magnitude. At age 9 the nation showed a mean change of -1.7 percentage points; the mean change for boys was -1.6 and -1.7 for girls. Thirteen-year-old boys showed a mean change of -1.9 percentage points; the girls showed a mean change of -2.0. Both groups closely resembled the changes for all 13-year-olds, -1.9 percentage points. Seventeen-year-olds had a national decline of -3.2 percentage points while boys had a decline of -3.4 and girls -3.0. Thus, the performance of both boys and girls declined at about the same rate; both groups showed declines similar to those observed nationally.

However, between 1969 and 1973 the differences between boys' and girls' science achievement remained remarkably static from 1969 to 1973. In both assessments, the gap between boys and girls increased dramatically with age: 2 percentage points at age 9, 4 at age 13 and 6 at age 17. On physical science exercises the gap was 3 percentage points at age 9, 6-7 at age 13 and 9 at age 17. Thus although both girls and boys showed general declines, boys continued to outperform girls in both assessments of science.

EXHIBIT 6. Changes for Boys and Girls, Age 9

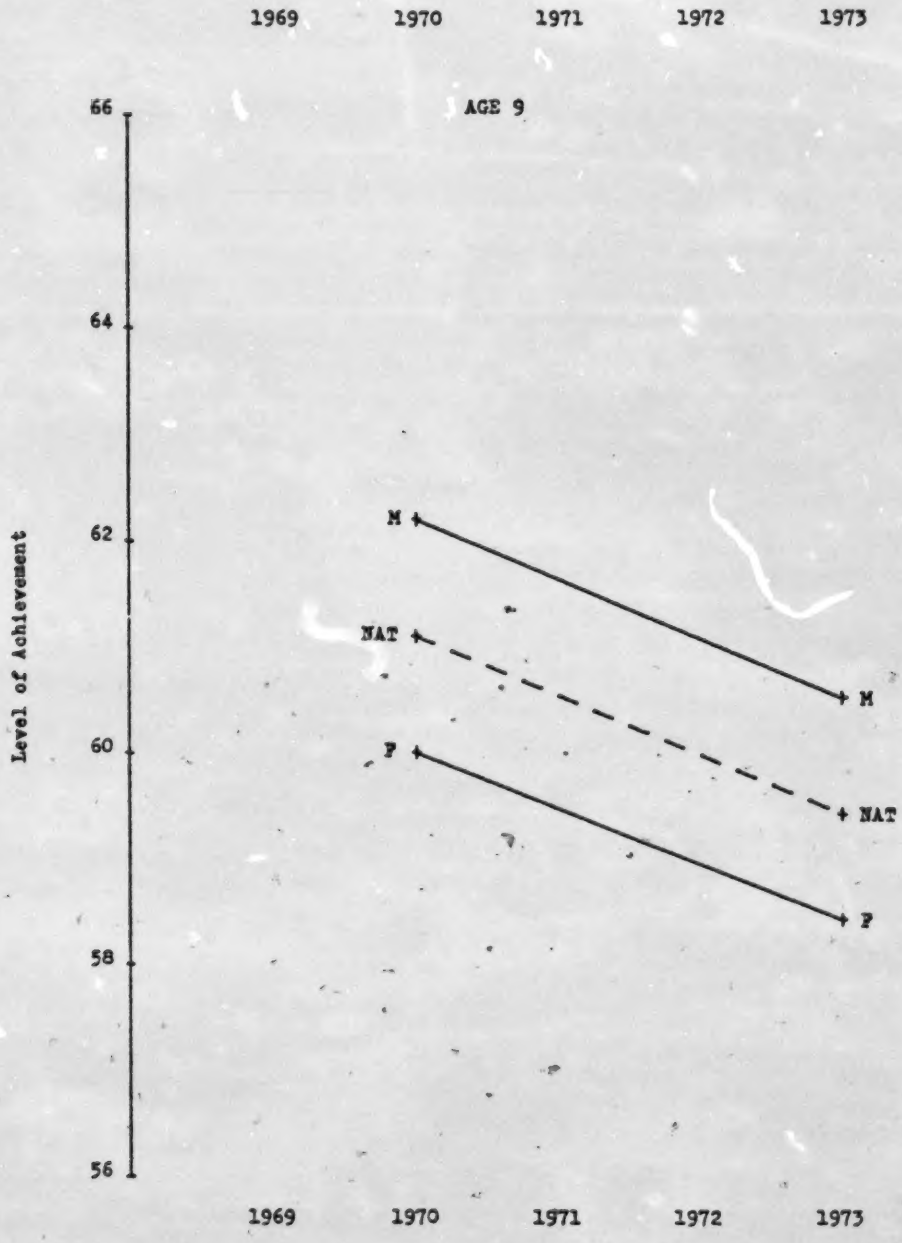


EXHIBIT 7. Changes for Boys and Girls, Age 13

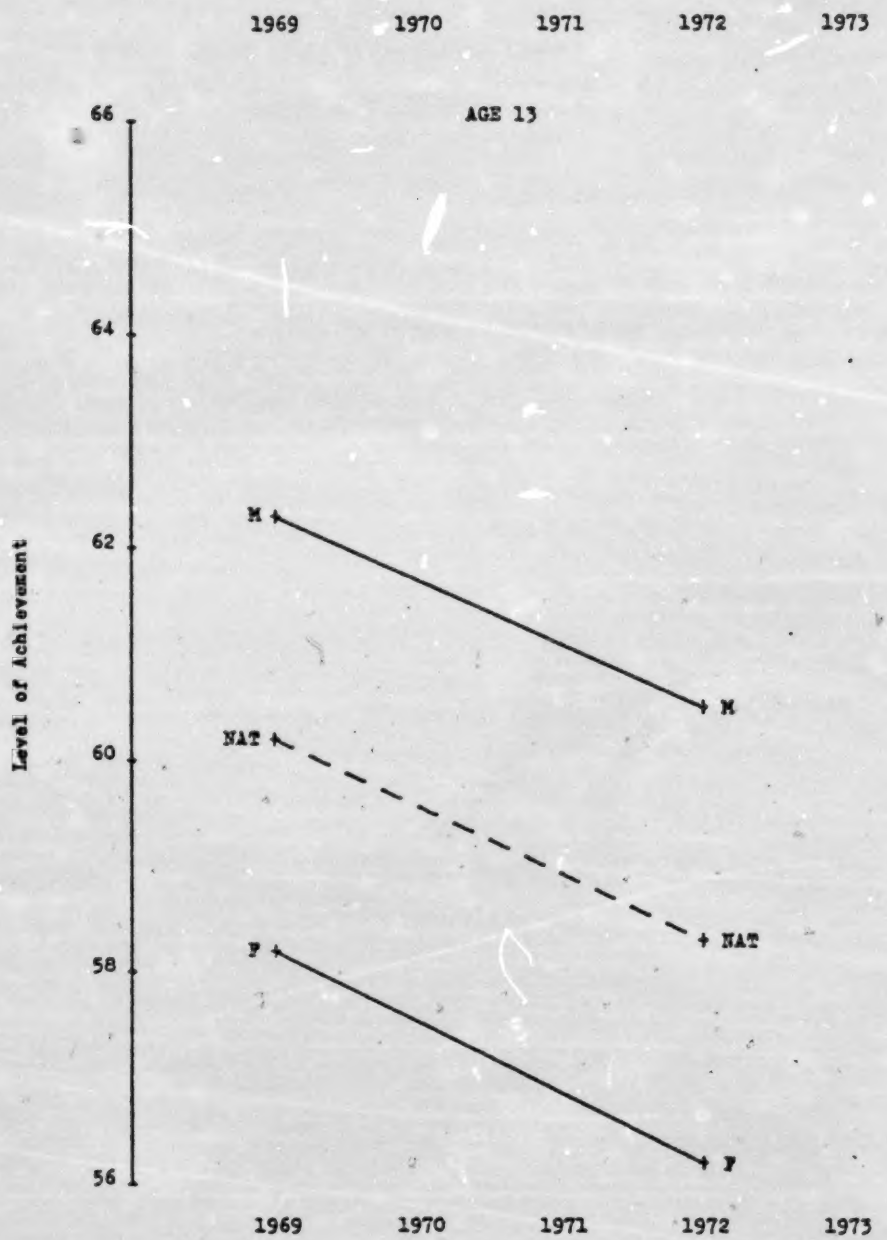
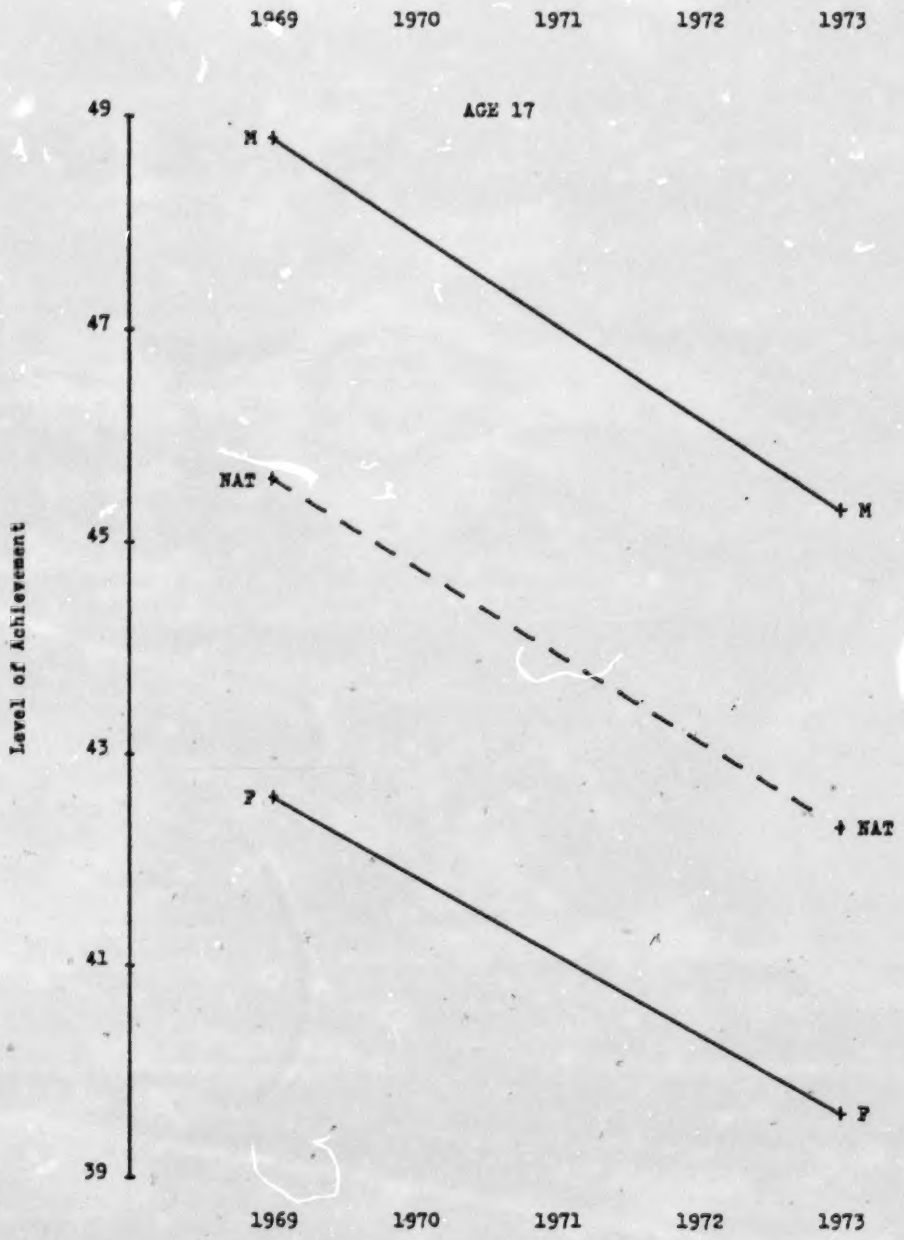


EXHIBIT 8. Changes for Boys and Girls, Age 17



Results for Blacks and Whites

Both Blacks and Whites showed average declines in performance closely paralleling the declines seen in the nation as a whole (see Exhibits 9 through 11). At age 9 the nation showed an average decline of 1.7 percentage points. Black performance declined an average of 0.9 percentage points, slightly less than the nation, while White performance declined an average 1.5 percentage points. The decline at age 13 was an average 3.2 percentage points for Blacks and 1.7 for Whites; nationally all 13-year-olds showed an average 1.9 percentage points decline. Seventeen-year-olds had a national decline of 3.2 percentage points while Blacks declined only 1.9 percentage points and Whites 2.7 percentage points. Although both Blacks and Whites showed average downward changes in performance, Black performance did not decline as much as White performance at ages 9 and 17 but declined more than Whites at age 13.

EXHIBIT 9. Changes for Blacks and Whites, Age 9

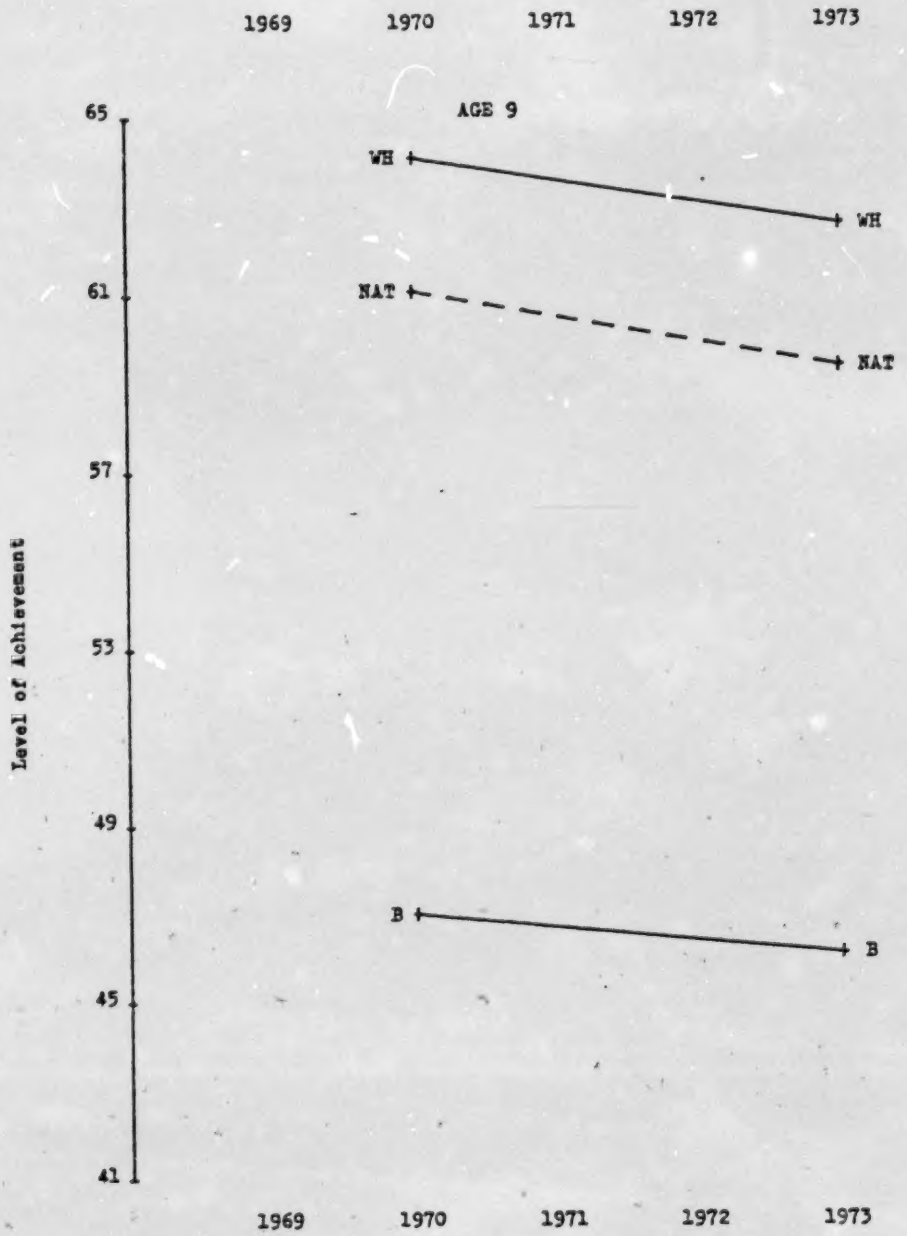


EXHIBIT 10. Changes for Blacks and Whites, Age 13

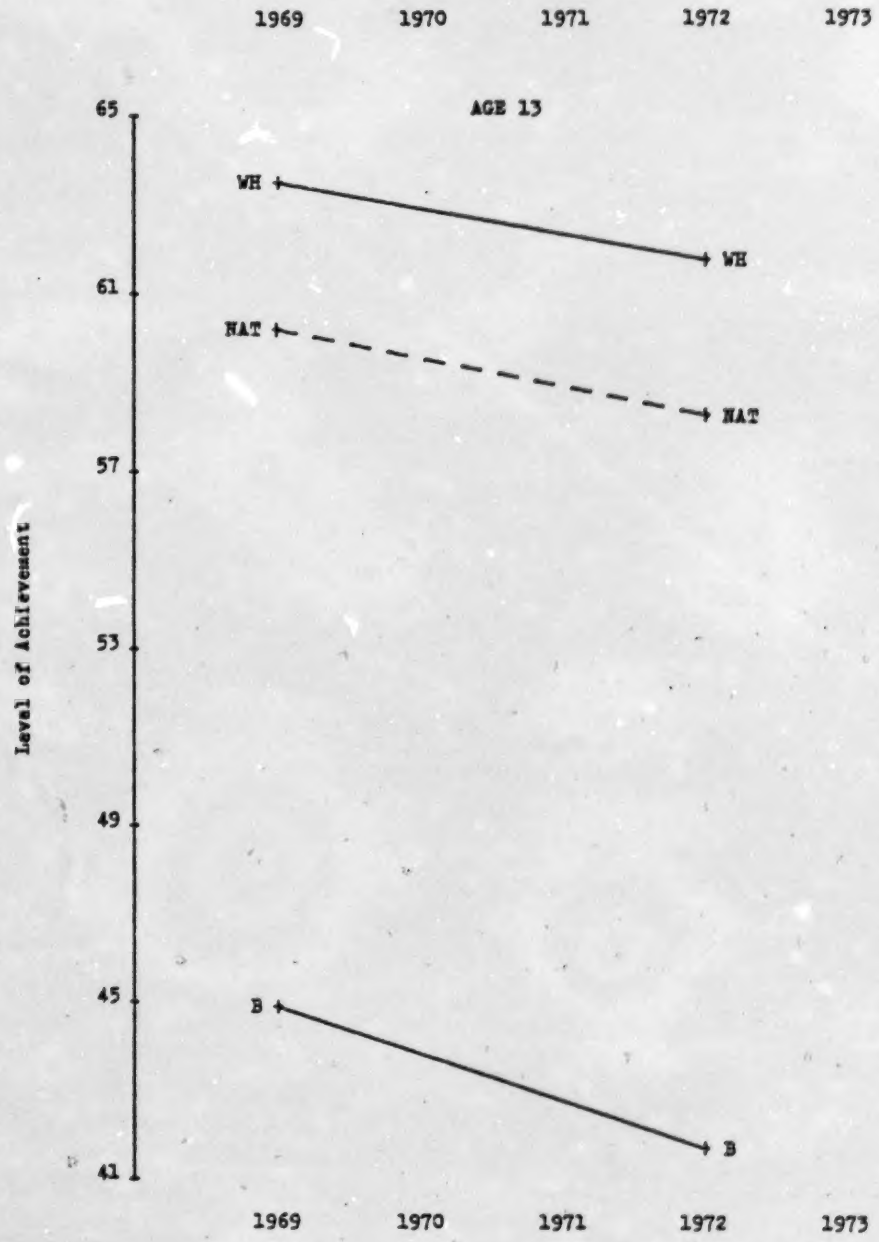
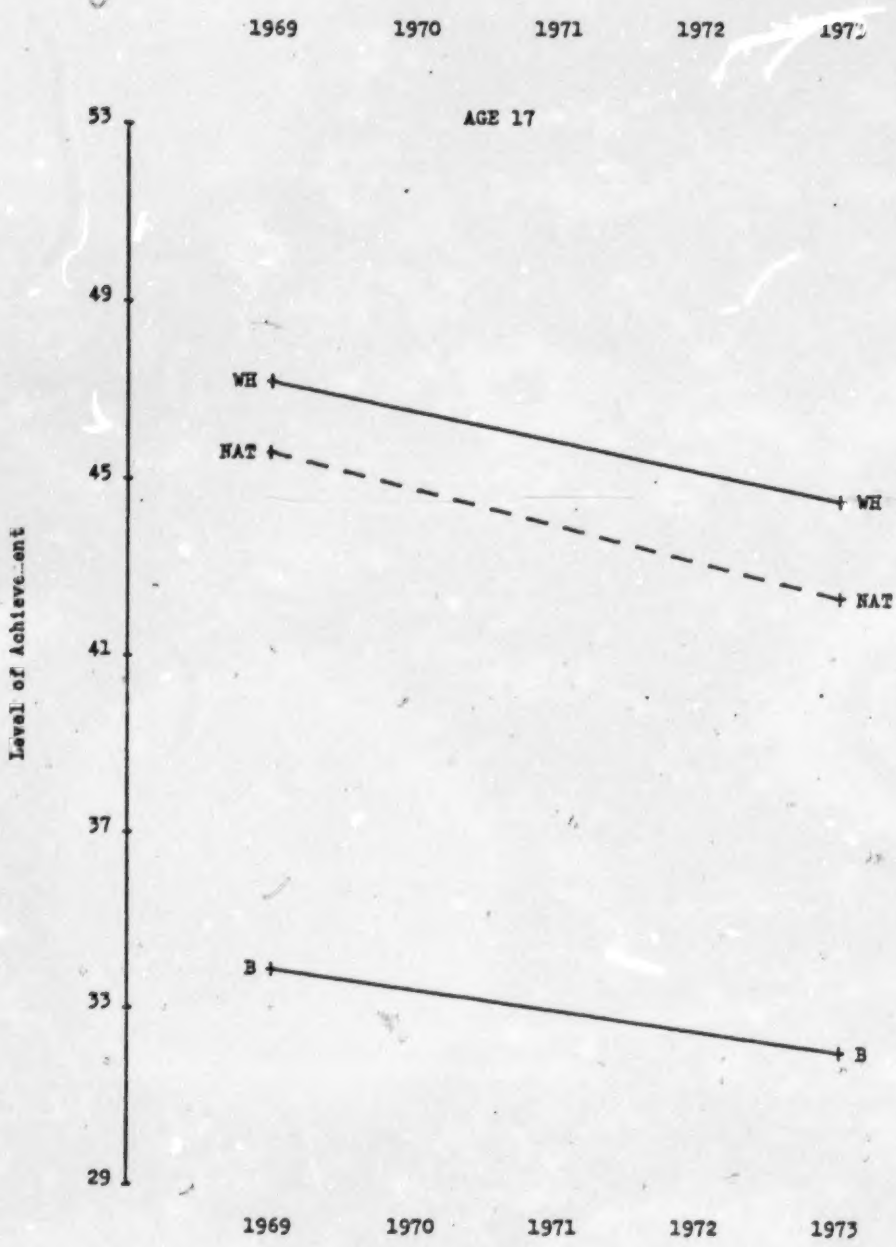


EXHIBIT 11. Changes for Blacks and Whites, Age 17



Results for Size and Type of Community Categories

The size and type of community (STOC) categories are defined by the size of the community in which a student's school is located and by an occupational profile of the area the school serves, as indicated by the school principal. Three of the categories are "extremes": extreme rural, low metro and high metro. Each of these categories represents the most extreme 10% of the respondents at each age level. The extreme rural category is comprised of students attending schools in rural areas where a high proportion of adults are farm workers and a low proportion are professional, managerial or factory workers. Similarly, the low metro category is comprised of all those respondents who attend schools in city areas where a high proportion of the adult population is either not regularly employed or on welfare and a low proportion is employed in professional or managerial positions. The third extreme category, high metro, is comprised of respondents attending schools in city and near-city areas where a high proportion of adults are employed in professional or managerial positions and a low proportion are factory or farm workers, not regularly employed or on welfare. The remaining respondents are classified into the four other STOC categories based on size of community in which the school is located:

Main big city. Schools in this group are located in big cities of population greater than 200,000 but not included in either the low metro or high metro categories.

Urban fringe. These schools are in the urbanized areas near big cities of size greater than 200,000 and not included in either the low metro or high metro categories.

Medium city. These schools are in cities with populations between 25,000 and 200,000 that are not urbanized areas near big cities.

Small places. Schools in this category are located in open country or are from places with populations of less than 25,000, not including those in the extreme rural group.

Most of the STOC categories showed a lower average performance in the second assessment at all three ages. The only notable exception was the extreme rural category: at ages 9 and 13 their average performance was higher in the second assessment, instead of lower, and at age 17 the decline for the extreme rural was the smallest of any of the STOC categories and well above the decline seen for all 17-year-olds. Thus, although all of the other six STOC categories showed average declines in science achievement at all three ages, the average performance in the extreme rural category declined at a slower rate than the nation at age 17 and actually improved at ages 9 and 13.

EXHIBIT 12. Changes for Size and Type of Community Categories, Age 9

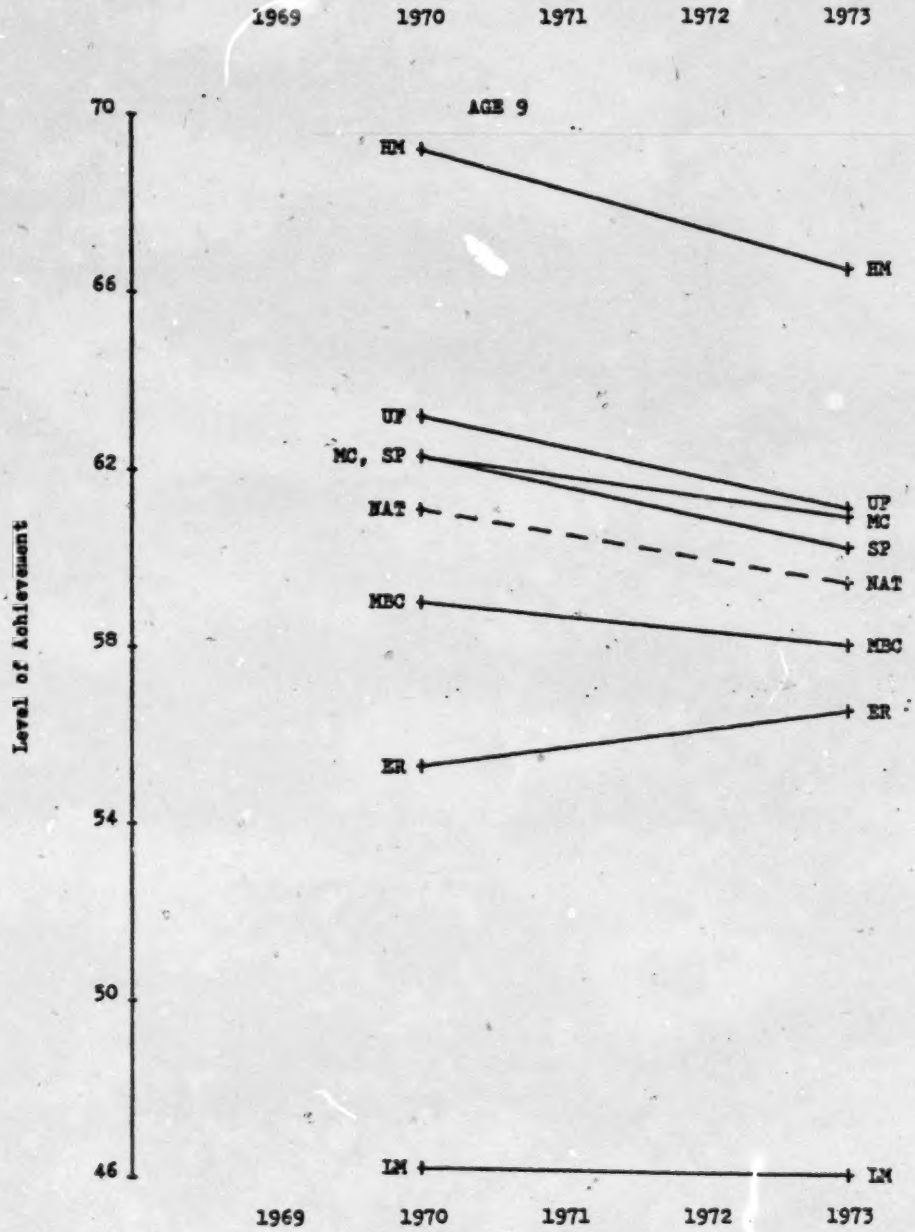


EXHIBIT 13. Changes for Size and Type of Community Categories, Age 13

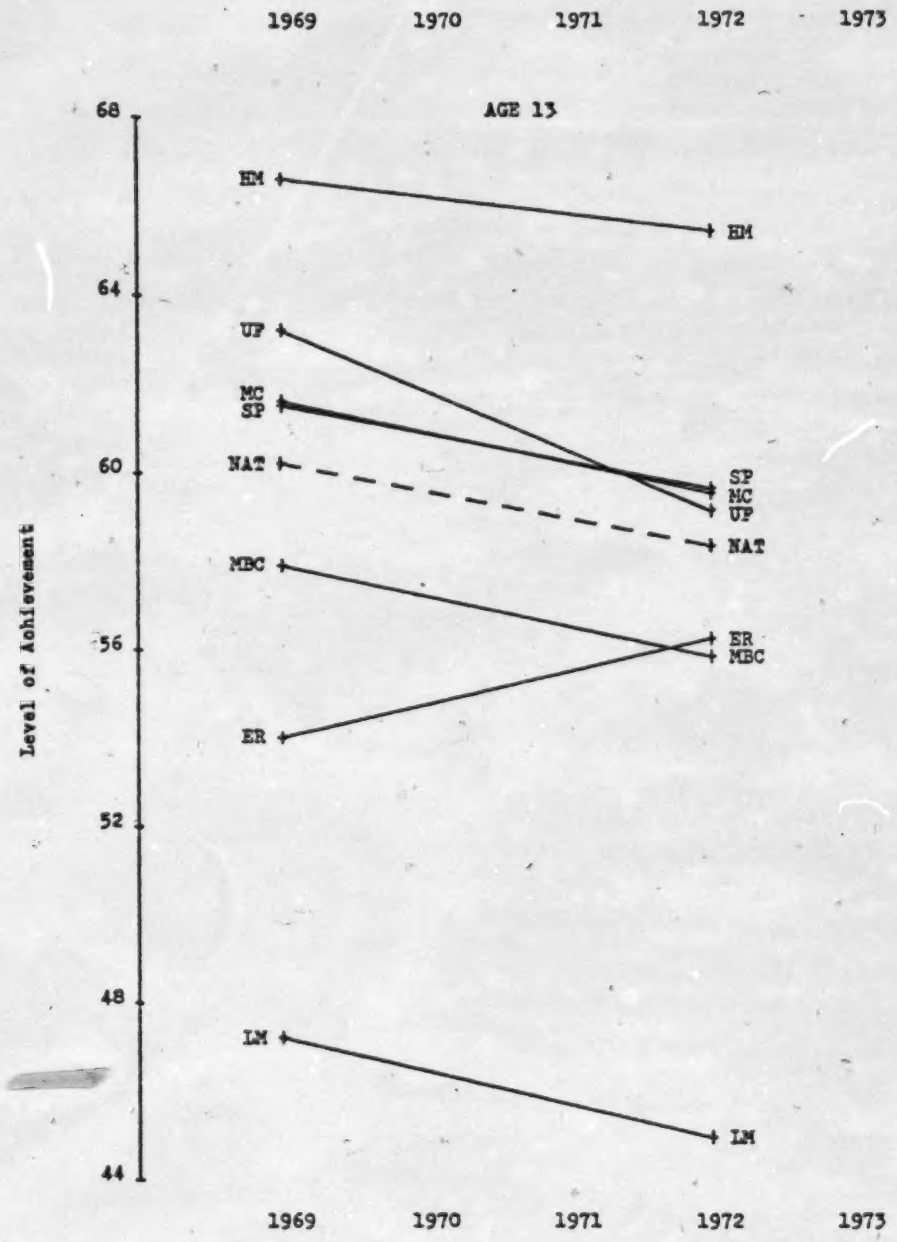
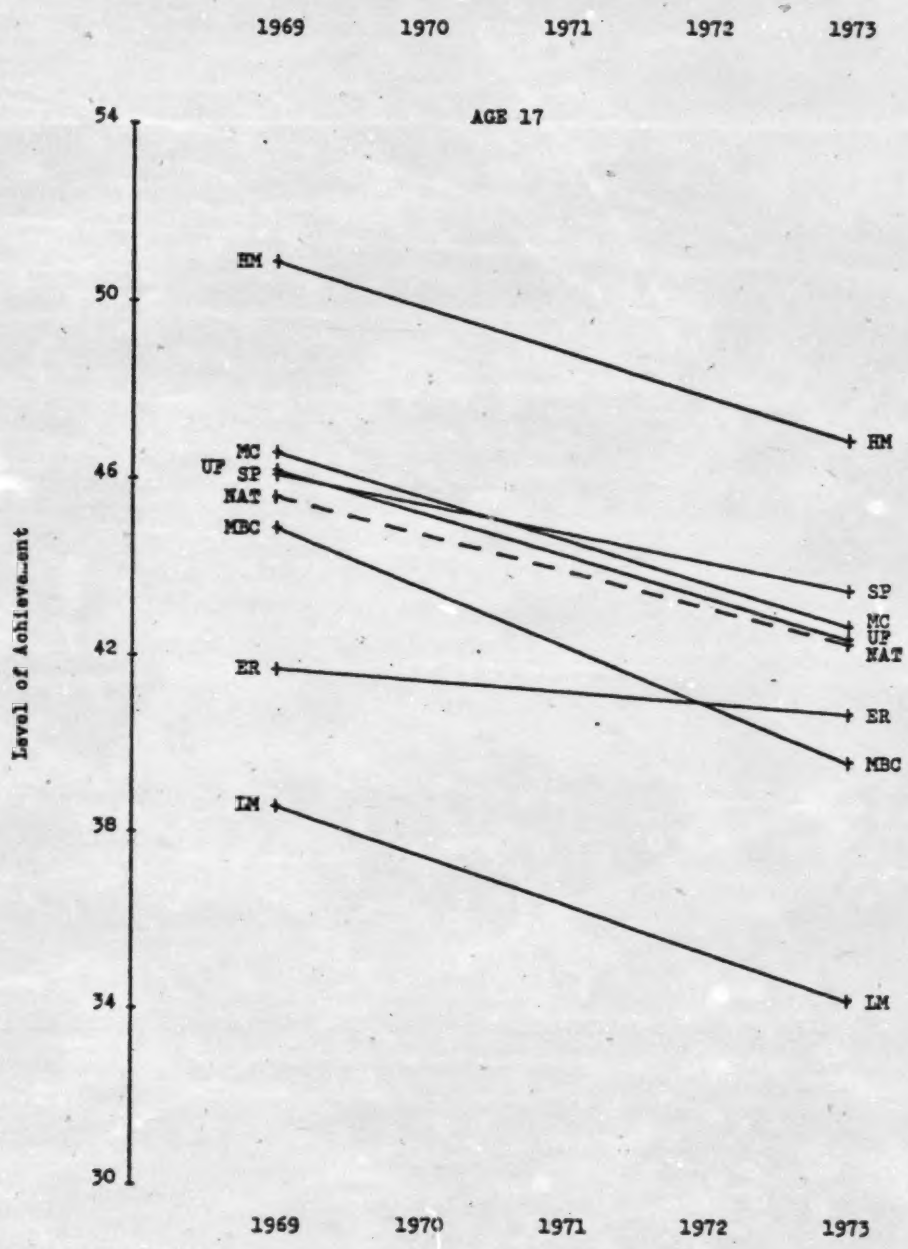


EXHIBIT 14. Changes for Size and Type of Community Categories, Age 17



APPENDIX A

SUMMARY TABLES

SUMMARY SCIENCE CHANGE DATA, MEAN PERCENTAGE CORRECT
1969-1973
(Standard errors in parentheses)*

	Age 9 (92)		
	Mean % Correct 1970	Mean % Correct 1973	Mean Change**
National	61.1(0.4)	59.4(0.5)	-1.7(0.6)
Region			
Northeast	63.4(0.5)	61.3(0.7)	-2.2(0.9)
Southeast	55.8(0.8)	55.4(1.0)	-0.4(1.3)
Central	62.6(0.7)	60.8(0.9)	-1.8(1.2)
West	61.4(0.8)	60.0(0.9)	-1.4(1.2)
Sex			
Males	62.2(0.4)	60.5(0.5)	-1.6(0.6)
Females	60.0(0.4)	58.4(0.5)	-1.7(0.6)
Color			
Whites	64.1(0.4)	62.6(0.4)	-1.5(0.5)
Blacks	47.0(0.8)	46.1(0.4)	-0.9(0.9)
Unknown	50.3(1.1)	51.3(1.1)	1.0(1.6)
Parental Education			
No high school	52.8(1.0)	53.3(0.9)	0.5(1.3)
Some high school	55.6(0.9)	55.9(0.9)	0.4(1.2)
Graduated high school	61.5(0.5)	60.5(0.5)	-1.0(0.7)
Post high school	67.0(0.4)	65.1(0.5)	-1.9(0.6)
Unknown	56.8(0.4)	55.6(0.5)	-1.2(0.6)
Size & Type of Community			
Extreme rural	55.3(1.5)	56.5(1.0)	1.2(1.8)
Low metro	46.2(1.2)	46.0(0.7)	-0.2(1.4)
High metro	69.2(1.0)	66.5(0.8)	-2.7(1.3)
Main big city	59.0(1.0)	58.0(1.2)	-1.0(1.6)
Urban fringe	63.2(0.8)	61.1(0.9)	-2.1(1.2)
Medium city	62.3(0.7)	60.9(1.3)	-1.3(1.5)
Small places	62.3(0.6)	60.2(0.8)	-2.1(1.0)

*All standard errors in this table are rounded figures. The standard error of change is calculated from the 1969-70 standard error (SE_1) and the 1972-73 standard error (SE_2) using the formula

$$(SE_1^2 + SE_2^2)^{\frac{1}{2}}.$$

**The mean change is the mean of the changes in performance for the exercises. The mean change is equal to the difference in the means of each year, but may differ in this chart due to rounding.

SUMMARY SCIENCE CHANGE DATA, MEAN PERCENTAGE CORRECT
1969-1973
(Standard errors in parentheses)*

	Age 13 (67)		
	Mean % Correct 1969	Mean % Correct 1972	Mean Change**
National	60.2(0.4)	58.3(0.5)	-1.9(0.6)
Region			
Northeast	62.0(0.8)	60.7(0.9)	-1.3(1.2)
Southeast	55.1(1.1)	55.4(0.9)	0.3(1.4)
Central	62.6(0.7)	59.9(1.0)	-2.8(1.2)
West	59.8(0.6)	56.9(0.9)	-2.9(1.1)
Sex			
Males	62.3(0.5)	60.5(0.5)	-1.9(0.7)
Females	58.2(0.5)	56.2(0.5)	-2.0(0.7)
Color			
Whites	63.5(0.3)	61.8(0.4)	-1.7(0.5)
Blacks	44.9(0.6)	41.7(0.5)	-3.2(0.8)
Unknown	49.6(1.0)	47.3(1.2)	-2.3(1.6)
Parental Education			
No high school	48.8(0.9)	49.4(1.0)	0.7(1.3)
Some high school	53.1(0.8)	52.2(0.7)	-0.9(1.1)
Graduated high school	58.5(0.5)	58.1(0.5)	-0.4(0.6)
Post high school	65.7(0.4)	64.9(0.4)	-0.9(0.6)
Unknown	52.2(1.0)	48.3(0.6)	-3.8(1.2)
Size & Type of Community			
Extreme rural	54.0(1.7)	56.2(1.3)	2.2(2.1)
Low metro	47.2(1.1)	44.9(1.3)	-2.3(1.7)
High metro	66.6(0.9)	65.4(0.8)	-1.2(1.2)
Main big city	57.9(1.3)	55.8(1.0)	-2.0(1.6)
Urban fringe	63.2(1.0)	59.1(0.9)	-4.1(1.3)
Medium city	61.6(1.0)	59.5(1.4)	-2.1(1.8)
Small places	61.5(0.6)	59.6(0.7)	-1.9(0.9)

*All standard errors in this table are rounded figures. The standard error of change is calculated from the 1969-70 standard error (SE_1) and the 1972-73 standard error (SE_2) using the formula $(SE_1^2 + SE_2^2)^{\frac{1}{2}}$.

**The mean change is the mean of the changes in performance for the exercises. The mean change is equal to the difference in the means of each year, but may differ in this chart due to rounding.

SUMMARY SCIENCE CHANGE DATA, MEAN PERCENTAGE CORRECT
1969-1973
(Standard errors in parentheses)*

	Age 17IS (64)		
	Mean % Correct 1969	Mean % Correct 1973	Mean Change**
National	45.6(0.3)	42.3(0.3)	-3.2(0.5)
Region			
Northeast	47.9(0.7)	44.4(0.5)	-3.5(0.8)
Southeast	42.4(0.6)	40.8(0.6)	-1.6(0.9)
Central	45.5(0.5)	42.5(0.8)	-3.0(0.9)
West	45.6(0.6)	41.1(0.7)	-4.5(0.9)
Sex			
Males	48.8(0.4)	45.3(0.4)	-3.4(0.6)
Females	42.6(0.4)	39.6(0.4)	-3.0(0.5)
Color			
Whites	47.2(0.3)	44.5(0.3)	-2.7(0.5)
Blacks	33.9(0.7)	32.0(0.6)	-1.9(0.9)
Unknown	41.0(1.2)	32.8(1.0)	-8.2(1.6)
Parental Education			
No high school	37.4(0.7)	35.0(0.7)	-2.4(1.0)
Some high school	40.4(0.5)	36.3(0.5)	-4.1(0.7)
Graduated high school	43.9(0.4)	41.1(0.3)	-2.7(0.5)
Post high school	49.5(0.4)	46.7(0.4)	-2.9(0.5)
Unknown	38.7(1.5)	34.0(1.2)	-4.8(1.9)
Size & Type of Community			
Extreme rural	41.7(1.1)	40.7(1.0)	-1.0(1.4)
Low metro	38.6(1.3)	34.2(1.3)	-4.5(1.8)
High metro	50.9(0.7)	46.9(1.1)	-4.1(1.3)
Main big city	44.9(0.8)	39.6(1.0)	-5.4(1.2)
Urban fringe	46.2(0.9)	42.4(1.0)	-3.9(1.3)
Medium city	46.6(1.1)	42.7(1.1)	-3.9(1.5)
Small places	46.1(0.6)	43.5(0.5)	-2.6(0.8)

*All standard errors in this table are rounded figures. The standard error of change is calculated from the 1969-70 standard error (SE_1) and the 1972-73 standard error (SE_2) using the formula

$$(SE_1^2 + SE_2^2)^{\frac{1}{2}}.$$

**The mean change is the mean of the changes in performance for the exercises. The mean change is equal to the difference in the means of each year, but may differ in this chart due to rounding.

SUMMARY SCIENCE CHANGE DATA, MEAN GROUP DIFFERENCES
1969-1973
(Standard errors in parentheses)*

	Age 9 (92)		
	Mean Group Diff. 1970	Mean Group Diff. 1973	Mean Change**
National	61.1(0.4)	59.4(0.5)	-1.7(0.6)
Region			
Northeast	2.3(0.5)	1.8(0.6)	-0.5(0.8)
Southeast	-5.4(0.7)	-4.1(0.9)	1.3(1.1)
Central	1.5(0.6)	1.4(0.8)	-0.1(1.0)
West	0.2(0.7)	0.6(0.8)	0.3(1.1)
Sex			
Males	1.0(0.1)	1.1(0.1)	0.0(0.2)
Females	-1.1(0.2)	-1.1(0.1)	0.0(0.2)
Color			
Whites	2.9(0.2)	3.1(0.3)	0.2(0.3)
Blacks	-14.2(0.7)	-13.4(0.6)	0.8(0.9)
Other	-10.9(1.0)	-8.1(1.1)	2.8(1.5)
Parental Education			
No high school	-8.3(0.9)	-6.1(0.8)	2.2(1.1)
Some high school	-5.6(0.8)	-3.5(0.8)	2.1(1.1)
Graduated high school	0.4(0.4)	1.1(0.3)	0.7(0.5)
Post high school	5.9(0.3)	5.7(0.2)	-0.2(0.4)
Unknown	-4.3(0.3)	-3.9(0.2)	0.4(0.4)
Size & Type of Community			
Extreme rural	-5.9(1.4)	-3.0(1.0)	2.9(1.7)
Low metro	-14.9(1.2)	-13.4(0.8)	1.5(1.4)
High metro	8.1(0.9)	7.1(0.8)	-1.0(1.2)
Main big city	-2.2(1.0)	-1.5(1.1)	0.7(1.5)
Urban fringe	2.1(0.8)	1.6(1.0)	-0.4(1.2)
Medium city	1.1(0.7)	1.5(1.2)	0.3(1.4)
Small places	1.2(0.5)	0.7(0.6)	-0.4(0.8)

*All standard errors in this table are rounded figures. The standard error of change is calculated from the 1969-70 standard error (SE_1) and the 1972-73 standard error (SE_2) using the formula

$$(SE_1^2 + SE_2^2)^{\frac{1}{2}}.$$

**The mean change is the mean of the changes in performance for the exercises. The mean change is equal to the difference in the means of each year, but may differ in this chart due to rounding.

SUMMARY SCIENCE CHANGE DATA, MEAN GROUP DIFFERENCES
1969-1973
(Standard errors in parentheses)*

	Age 13 (67)		
	Mean Group Diff. 1969	Mean Group Diff. 1972	Mean Change**
National	60.2(0.4)	58.3(0.5)	-1.9(0.6)
Region			
Northeast	1.8(0.7)	2.4(0.8)	0.5(1.0)
Southeast	-5.1(0.9)	-2.9(0.9)	2.2(1.3)
Central	2.4(0.6)	1.6(0.8)	-0.9(1.0)
West	-0.4(0.6)	-1.4(0.8)	-1.0(1.0)
Sex			
Males	2.1(0.2)	2.1(0.2)	-0.0(0.3)
Females	-2.0(0.2)	-2.1(0.2)	-0.1(0.3)
Color			
Whites	3.3(0.3)	3.5(0.3)	0.2(0.4)
Blacks	-15.3(0.6)	-16.6(0.6)	-1.4(0.8)
Other	-10.6(1.0)	-11.0(1.1)	-0.4(1.5)
Parental Education			
No high school	-11.4(0.9)	-8.9(0.9)	2.5(1.2)
Some high school	-7.1(0.7)	-6.1(0.6)	1.0(0.9)
Graduated high school	-1.7(0.3)	-0.2(0.3)	1.5(0.5)
Post high school	5.5(0.3)	6.6(0.3)	1.0(0.4)
Unknown	-8.0(1.0)	-10.0(0.5)	-1.9(1.1)
Size & Type of Community			
Extreme rural	-6.2(1.6)	-2.2(1.2)	4.0(2.0)
Low metro	-13.0(1.1)	-13.5(1.3)	-0.5(1.7)
High metro	6.4(0.9)	7.1(0.8)	0.7(1.2)
Main big city	-2.3(1.3)	-2.5(1.0)	-0.2(1.6)
Urban fringe	3.0(1.0)	0.8(0.9)	-2.2(1.4)
Medium city	1.4(1.0)	1.2(1.3)	-0.2(1.6)
Small places	1.3(0.5)	1.3(0.6)	-0.0(0.7)

*All standard errors in this table are rounded figures. The standard error of change is calculated from the 1969-70 standard error (SE_1) and the 1972-73 standard error (SE_2) using the formula

$$(SE_1^2 + SE_2^2)^{\frac{1}{2}}.$$

**The mean change is the mean of the changes in performance for the exercises. The mean change is equal to the difference in the means of each year, but may differ in this chart due to rounding.

SUMMARY SCIENCE CHANGE DATA, MEAN GROUP DIFFERENCES
1969-1973
(Standard errors in parentheses)*

	Age 17IS (64)		
	Mean Group Diff. 1969	Mean Group Diff. 1973	Mean Change**
National	45.6(0.3)	42.3(0.3)	-3.2(0.5)
Region			
Northeast	2.3(0.6)	2.0(0.5)	-0.3(0.8)
Southeast	-3.2(0.6)	-1.6(0.6)	1.7(0.8)
Central	-0.1(0.5)	0.2(0.6)	0.3(0.8)
West	0.0(0.5)	-1.2(0.6)	-1.2(0.8)
Sex			
Males	3.2(0.2)	3.0(0.2)	-0.2(0.3)
Females	-3.0(0.2)	-2.8(0.2)	0.3(0.3)
Color			
Whites	1.6(0.2)	2.1(0.2)	0.5(0.3)
Blacks	-11.6(0.7)	-10.3(0.6)	1.3(0.9)
Other	-4.5(1.2)	-9.5(1.0)	-5.0(1.6)
Parental Education			
No high school	-8.2(0.7)	-7.4(0.7)	0.8(1.0)
Some high school	-5.2(0.4)	-6.0(0.5)	-0.8(0.7)
Graduated high school	-1.7(0.3)	-1.2(0.3)	0.5(0.4)
Post high school	4.0(0.3)	4.3(0.3)	0.4(0.4)
Unknown	-6.8(1.5)	-8.4(1.1)	-1.5(1.8)
Size & Type of Community			
Extreme rural	-3.9(1.1)	-1.6(0.9)	2.3(1.4)
Low metro	-6.9(1.2)	-8.2(1.3)	-1.2(1.8)
High metro	5.4(0.7)	4.5(1.0)	-0.8(1.2)
Main big city	-0.6(0.8)	-2.8(1.0)	-2.1(1.2)
Urban fringe	0.7(0.9)	0.0(0.9)	-0.6(1.3)
Medium city	1.0(1.0)	0.4(1.0)	-0.7(1.4)
Small places	0.6(0.5)	1.2(0.5)	0.6(0.7)

*All standard errors in this table are rounded figures. The standard error of change is calculated from the 1969-70 standard error (SE_1) and the 1972-73 standard error (SE_2) using the formula

$$(SE_1^2 + SE_2^2)^{\frac{1}{2}}.$$

**The mean change is the mean of the changes in performance for the exercises. The mean change is equal to the difference in the means or each year, but may differ in this chart due to rounding.